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Seabird Inventory at Haleakalā National Park, Maui, Hawai`i

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Table of Contents

List of Tables ..... **i**

List of Figures ..... **i**

Abstract **1**

Introduction **1**

Methods **3**
Site Description 3
Call Counts 5
Ground-based Visual Surveys 6

Results **8**
Call Counts 8
Ground-based Visual Surveys 8

Discussion and Recommendations **9**

Acknowledgements **12**

Literature Cited **12**

Appendix **14**

CHECKLIST OF SEABIRDS AT HALEAKALĀ NATIONAL PARK **14**

LIST OF TABLES

Table 1. Locations, dates, and number of nights that three-hour call counts were conducted at Haleakalā National Park. 8

Table 2. Seabirds observed during shoreline surveys at Haleakalā National Park, July 2005. 9

LIST OF FIGURES

Figure 1. `Ua`u fledgling exiting burrow at Haleakalā National Park, 13 October 2007. Photo taken by remote camera. 2

Figure 2. Haleakalā National Park, Maui, Hawai`i, 2009. 4

Figure 3. Locations of seabird auditory call-count surveys at Haleakalā National Park, 2009. 6

Figure 4. Locations of seabird ground-based visual surveys along the shoreline (4a) and Kaupō Trail (4b) at Haleakalā National Park, 2006. 7

ABSTRACT

We conducted presence or absence and distribution surveys for seabirds throughout Haleakalā National Park from April through August 2005. Results showed the presence of `Ua`u (Hawaiian Petrel, *Pterodroma sandwichensis*), Koa`e Kea (White-tailed Tropicbird, *Phaethon lepturus dorotheae*), `Iwa (Great Frigatebird, *Fregata minor palmerstoni*), and Noio (Hawaiian Noddy, *Anous minutus melanogenys*). Although `A`o (Newell's Shearwater, *Puffinus auricularis newelli*) was not detected during the survey, this species is often heard in Kīpahulu Valley. `Ake`ake (Band-rumped Storm-Petrel, *Oceanodroma castro*) were not detected during the surveys but are likely to occur in Haleakalā National Park.

INTRODUCTION

Most breeding seabird populations within national parks in Hawai`i are poorly known. Taxonomic specialists and a steering committee at the National Park Service Biological Inventories Workshop held in January 2000 identified the need to inventory breeding seabird populations at national parks in Hawai`i as a high priority. The primary objective of this inventory was to determine the presence or absence and distribution of seabird species at Haleakalā National Park (HALE), Maui.

`Ua`u (Hawaiian Petrel, *Pterodroma sandwichensis*) is the only seabird in Hawai`i that is federally listed as endangered (Figure 1). The `Ua`u at HALE is the only population of seabirds in Hawai`i national parks that is intensively monitored and managed. Monitoring for `Ua`u distribution and breeding success at HALE occurs annually as part of regular resource management activities, and has since 1980 (Simons 1983; Hodges 1994; Hodges and Nagata 2001; HALE unpubl. annual reports to USFWS). `Ua`u in HALE nest in burrows, most of which are located along the steep cliffs of the western rim of Haleakalā Crater. There are currently more than 1,000 known `Ua`u burrows at HALE, of which about 60% are occupied by `Ua`u each year (HALE unpubl. data). `Ua`u are present at Haleakalā from February through October and are absent from November through January. HALE staff search for new burrows and check existing burrows at least once a month while the `Ua`u are present. `Ua`u fly over land only at night and can be detected by distinctive calls. Calls are commonly heard throughout Haleakalā Crater from March through September each year (HALE unpubl. data). Since the objective of this inventory is to record presence or absence of species, and intensive monitoring of `Ua`u is already being conducted, this inventory documented only observations of this species for areas where they were previously not recorded.

Figure 1. `Ua`u fledgling exiting burrow at Haleakalā National Park, 13 October 2007. Photo taken by remote camera.

`A`o (Newell's Shearwater, *Puffinus auricularis newelli*) is federally listed as threatened. The majority of the breeding population nests in remote, densely vegetated areas on Kaua`i Island. Historically, `A`o were abundant in Hawai`i. Although fossil records have not been recorded, subfossil bones indicate that this species has always been uncommon in lowland areas (Ainley et al. 1997). As with `Ua`u, `A`o nest in burrows, fly over land only at night, and can be detected by distinctive calls. HALE field crews have reported calls that are descriptive of `A`o from various locations within Kīpahulu Valley and along the northern slope of Mount Haleakalā near Ko`olau Gap (HALE unpubl. data). One `A`o was heard calling in Kīpahulu Valley from a patch of native forest at 530 m (1,750 ft) above Pua`alu`u Stream and may have been nesting in the area (Stemmerman 1980). `A`o are seasonal nesters and are at the nesting colony from late April to early November each year (Ainley et al. 1997). Nest searches for `A`o at HALE have never been conducted.

Based on the timing of radar observations, individuals that probably were `A`o were recorded flying inland at the mouths of Kīpahulu Valley, Kaupō Gap, and Ko`olau Gap (Cooper and Day 2003). Radar observations after ~60 min past sunset were identified as `A`o based on observations of `A`o on Kaua`i Island. Day and Cooper (1995) and Day et al. (2003) found that `Ua`u movements were completed by ~60 min past sunset, while `A`o flights began ~30 min past sunset and continued beyond ~60 min past sunset. However, recent studies on Lāna`i Island show that `Ua`u may move inland well after dark, within approximately one hour past complete darkness (Brian Cooper, pers. comm.).

`Ake`ake (Band-rumped Storm-Petrel, *Oceanodroma castro*) is a candidate species for federal listing as threatened or endangered. `Ake`ake are widespread and found in the subtropics and tropics of the Pacific and Atlantic oceans (Harris 1969). The population in

Hawai`i is probably remnant, with possibly only a few hundred birds in all (Harrison et al. 1984; Harrison et al. 1990). As with `Ua`u and `A`o, `Ake`ake nest in burrows, fly over land only at night, and can be detected by distinctive calls. Loope et al. (1991) reported hearing, "a loud, raucous call tentatively identified as a Band-rumped Storm-Petrel" flying over the bogs of HALE in the evening. `Ake`ake were detected in Haleakalā Crater during breeding-season surveys conducted in 1992 (Hodges 1992a). `Ake`ake are suspected to return to their nesting colony in late April of each year (Harrison et al. 1990). Their departure date is unknown; however, based upon observations at Haleakalā and Mauna Loa on Hawai`i Island, we know that `Ake`ake are at their colonies through the summer months (Hodges 1992a, 1992b). `Ake`ake nests have not been located at HALE. `Ake`ake may nest at sea level based on nocturnal call detections known from Maui and Lāna`i.

Koa`e Kea (White-tailed Tropicbird, *Phaethon lepturus dorotheae*), `Iwa (Great Frigatebird, *Fregata minor palmerstoni*), and Noio (Hawaiian Noddy, *Anous minutus melanogenys*) are regularly seen at HALE (Conant and Stemmerman 1979; Stemmerman 1980; HALE unpubl. data). Koa`e Kea frequently fly over the cliffs above Haleakalā Crater, Ko`olau Gap, Kaupō Gap, Ka`āpahu, and `Ohe`o (Stemmerman 1976; Conant and Stemmerman 1979; HALE unpubl. data; Kozar et al. 2007) and have been seen landing at nesting sites in Kaupō Gap (pers. obs.). `Iwa frequently fly over the coastlines of `Ohe`o and Ka`āpahu (Stemmerman 1980), but are not known to nest in or near HALE. Noio fly over the coastlines at `Ohe`o and Ka`āpahu and have been seen flying to nest sites at `Ohe`o (pers. obs.).

Seabirds are important to the Hawaiian people and to the Hawaiian culture (Malo 1971; Gordean Bailey, Timmy Bailey, Terry Lind, and Noealani Lee, pers. comm.). Though their importance is shared through traditional practices (i.e., story telling, chants, hula dances, petroglyphs, pictographs, etc.), it is rarely found in written literature. Hawaiian families use the life history and biology of species such as the `A`o and `Ua`u to relate to the geneology of their families. Seabirds were an important food source for the Hawaiian people and still help fishermen locate fish schools. Sailors navigate and forecast the weather by observing the flights and timing of seabirds.

Out of respect for the Hawaiian culture, Hawaiian bird names are used in this report. Hawaiian names differ from the vernacular names given by Pyle (2002) and listed in the Appendix.

METHODS

Site Description

Haleakalā National Park is located on the eastern portion of the island of Maui, Hawai`i (Figure 2). The park encompasses about 12,215 ha (30,183 ac) of federal land and contains a variety of ecosystems, extending from sea level to the 3,037 m (10,023 ft) summit of Mount Haleakalā. Haleakalā Crater and Kīpahulu Valley dominate the park.

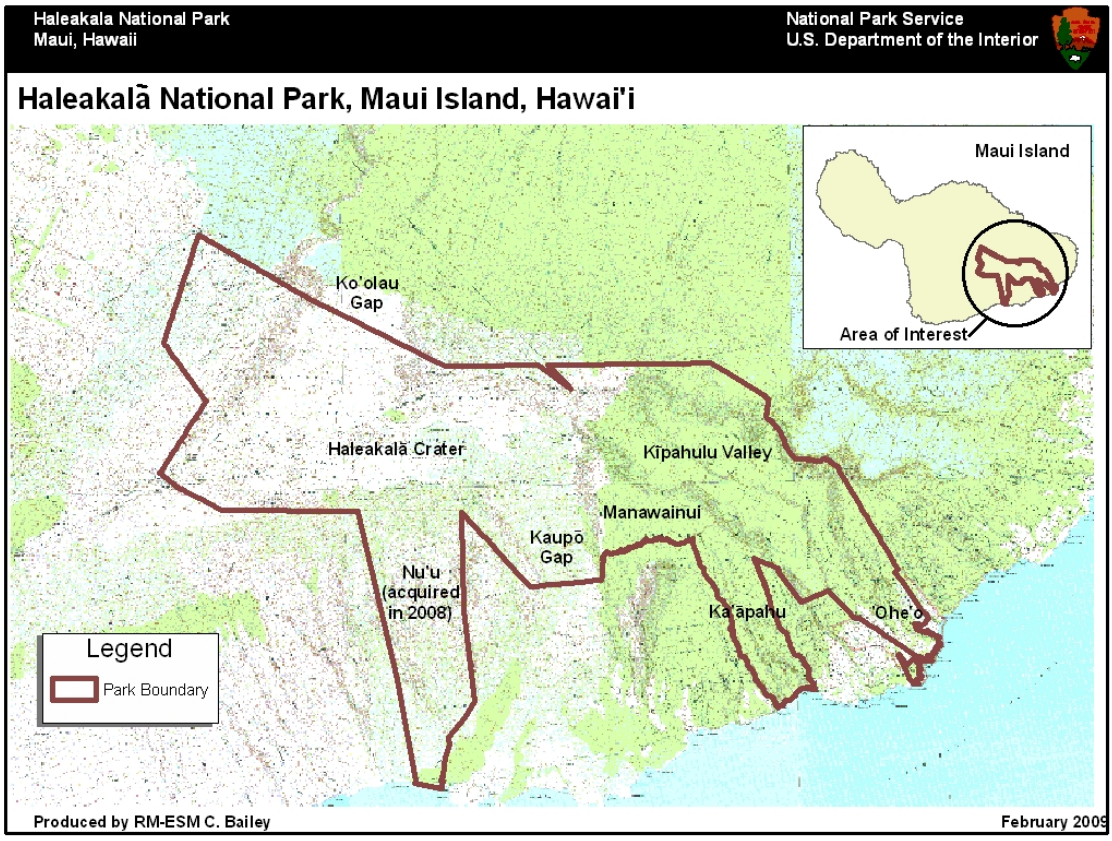

Figure 2. Haleakalā National Park, Maui, Hawai`i, 2009.

Haleakalā Crater is an erosional depression with volcanic activity as recent as about 500 years ago. There are steep cliffs and a number of cinder cones formed by a series of later eruptions inside Haleakalā Crater. Two valleys that were formed by thousands of years of erosion breach Haleakalā Crater: Ko`olau Gap to the northwest and Kaupō Gap to the southeast. Three ecosystems characterize the areas of Haleakalā Crater (Medeiros et al. 1998). The alpine (aeolian) zone occurs within the cinder deserts of Haleakalā Crater above 2,000 m (6,560 ft) and on the outside western slope of the volcano above 2,600 m (8,530 ft). Subalpine shrublands occur primarily on the northwestern flanks of Mount Haleakalā and extend from 2,050 m (6,724 ft) to the alpine zone at 2,600 m (8,530 ft). Subalpine grasslands are found on the northeastern flank of Mount Haleakalā and occur above 2,121 m (7,000 ft).

Rainforests occur throughout Kīpahulu Valley, Manawainui, and Ka`āpahu in the eastern portion of the park on the windward side of the island. Dense rainforests extend from the central Manawainui area, through Ka`āpahu and Kīpahulu Valley to the northeastern boundary of the park (Medeiros et al. 1998).

`Ohe`o is at sea level at the mouth of Kīpahulu Valley and contains approximately 3.5 km (~two miles) of shoreline. The shoreline at `Ohe`o consists of rocky, vegetated ledges, pastures that were previously used for cattle ranching, a ranger station, restroom

facilities, and a public campsite. The public accesses this rural area via a state highway. The shoreline of Ka`āpahu is approximately 1.6 km (one mile) long and consists of a beach of large boulders adjacent to tall rocky cliffs that extend as high as 150 m (500 ft). The rural state highway runs between the beach and the cliffs.

Nu`u is a new addition to the park. This section was acquired in 2008 and is in need of baseline inventories.

Introduced predators are controlled in and around Haleakalā Crater to protect endangered ground-nesting `Ua`u and Nēnē (Hawaiian Goose, *Branta sandvicensis*). A feral animal control fence encloses Haleakalā Crater and much of Manawainui and Kīpahulu Valley. Although large numbers of feral pigs (*Sus scrofa*) and goats (*Capra hircus*) were removed from these areas by the early 1990s, this region is still recovering from decades of disturbance. Ka`āpahu, where large populations of feral pigs and goats reside, was acquired by the National Park Service in 1999. It is not enclosed by a feral animal control fence and is not actively managed at this time.

Call Counts

To determine the presence or absence of `A`o and `Ake`ake, call-count surveys were conducted during the species' nesting season, from 25 April through 2 September 2005. Observers were stationed at 14 locations throughout Haleakalā National Park (Figure 3). Of the 14 locations, eight were in mid-elevation (610 to 1524 m [2,000 to 5,000 ft]) rainforest locations, three were in upper-elevation (2073 to 2286 m [6,800–7,500 ft]) shrubland, and three were in upper-elevation (2073 to 2286 m [6,800–7,500 ft]) alpine areas. Locations were chosen based upon historical observations (HALE unpubl. data) and previous radar-based surveys (Cooper and Day 2003). `A`o begin flying inland about 30 minutes after sunset (Day and Cooper 1995). There is no information on the time that `Ake`ake begin flying inland. No call counts for seabirds were performed at sea level areas and certain birds may have remained undetected.

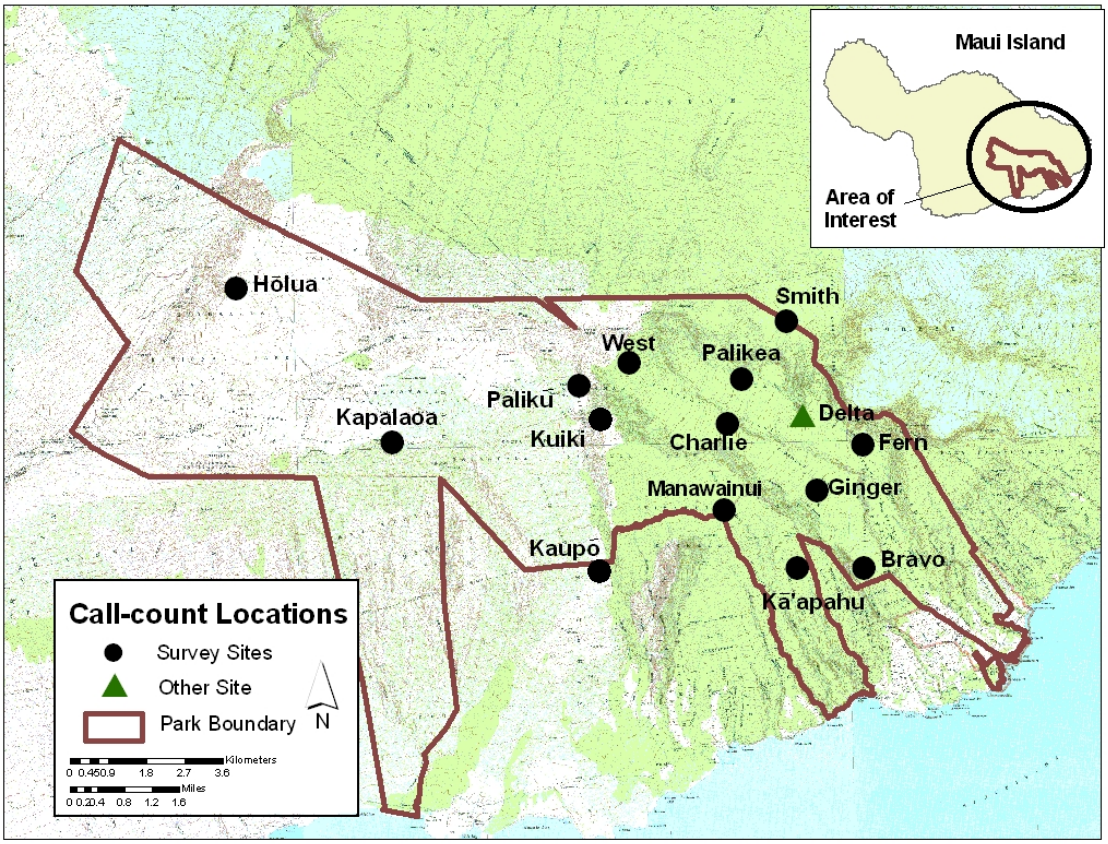

Figure 3. Locations of seabird auditory call-count surveys at Haleakalā National Park, 2009**.** (Delta site was not included in this survey, but is shown here for reference as `A`o have been heard at that location.)

`Ua`u are regularly heard and seen flying at night at Kapalaoa and Hōlua within Haleakalā Crater and occasionally heard and seen at Palikū and Kaupō and were not recorded from these locations. Data from Kaupō are anecdotal.

Sunset times ranged from 1849 to 1918 h. Observers listened for calls between 1900 and 2200 h. If calls were heard, observers looked for the bird with binoculars and recorded species, time, and location. Direction of flight and height of calls above the ground were estimated and recorded, if possible.

Ground-based Visual Surveys

For seabird species that were visible during the day, we conducted shoreline surveys on 26 and 27 July 2005 by walking along the coastlines of `Ohe`o and Ka`āpahu (Figure 4a). Observers walked along the shoreline from 1000 to 1300 h on both days and used binoculars to search over land and the ocean for seabirds. Additionally, one survey was conducted along Kaupō Trail on 9 June 2005 (Figure 4b). Observers walked along Kaupō Trail from Palikū to the park boundary at about 1,212 m (4,000 ft) elevation from 1000 to 1300 h. Observers recorded species, time, location, number of birds observed, and activity of birds.

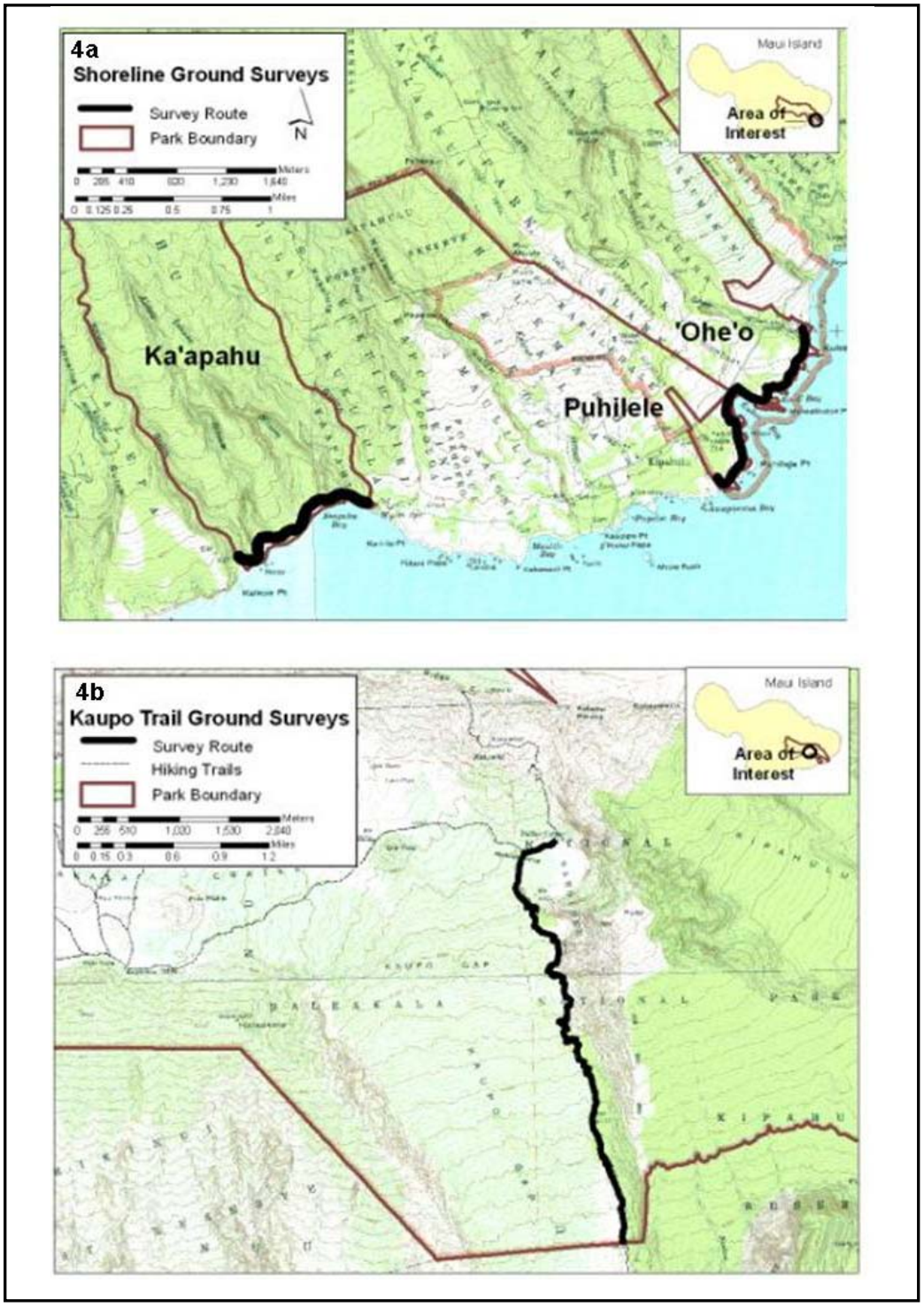

Figure 4. Locations of seabird ground-based visual surveys along the shoreline (4a) and Kaupō Trail (4b) at Haleakalā National Park, 2006.

RESULTS

Call Counts

Observers listened for calls for 64 nights for a total of 192 hours (Table 1). We did not detect `A`o or `Ake`ake during nighttime observations from any location, however, we recorded unprecedented observations (those that were not historically recorded at specific areas) of `Ua`u. At Kuiki, there was an `Ua`u observation (about 2130 h on 28 April 2005) where this species has not been recorded previously. This bird was flying overhead and traveling in a northwesterly direction. At Kaupō Gap, we heard 12 `Ua`u calls between 1932 and 2100 h on 18 May 2005; all birds were flying overhead and traveling in a northwesterly direction. In addition, we heard two `Ua`u calls on each of the nights of 18 July (1906 h) and 27 July (1903 h) 2005; the birds were flying overhead in a northeasterly direction from Kaupō Gap toward Manawainui. We also heard and saw one `Ua`u on 29 July 2005 (1916 h), flying in a northwesterly direction from Kaupō Gap toward Haleakalā Peak.

Table 1. *Locations, dates, and number of nights that three-hour call counts were conducted at Haleakalā National Park.*

Camp	Dates	Nights
Bravo	5/11–5/13	2
Charlie	4/26–4/29	3
Fern	5/3–5/6	3
Ginger	5/10, 6/13–6/17	5
Hōlua	5/10, 5/26, 8/3–8/4	3
Ka`āpahu	5/17	1
Kapalaoa	5/24–5/27, 6/20–6/22, 7/20–7/22	7
Kaupō	5/18, 7/13–7/14, 7/18–7/22, 7/25–7/29, 8/1–8/5, 8/29–9/2	14
Kuiki	4/25–4/29	4
Manawainui	4/25–4/29, 8/1–8/5	8
Palikea	5/2–5/10	8
Palikū	5/15–5/17	2
Smith	5/10–5/13	3
West	4/25	1
	Total Nights	64

Ground-based Visual Surveys

Koa`e Kea, `Iwa, and Noio were observed during shoreline and Kaupō trail surveys (Table 2). Koa`e Kea were observed flying about 100 m (328 ft) inland at `Ohe`o and over cliffs above Ka`āpahu and Kaupō. `Iwa were flying about 75 m (246 ft) inland at `Ohe`o and about 30 m (98 ft) from the shore over the ocean at Ka`āpahu. Seven Noio were observed at the mouth of `Ohe`o Stream. All Noio were flying about 15 m (49 ft)

from the shore over the ocean, then landing in crevices under the shoreline cliffs at the mouth of `Ohe`o Stream.

Table 2. *Seabirds observed during shoreline surveys at Haleakalā National Park, July 2005.*

Species	Number Observed	Location(s)	Activity
Koa`e Kea	5	`Ohe`o, Puhilele, Ka`āpahu, Kaupō	Flying over land
`Iwa	2	`Ohe`o, Ka`āpahu	Flying over land (`Ohe`o) Flying over ocean (Ka`āpahu)
Noio	7	`Ohe`o	Flying over ocean and into shoreline cliff at mouth of `Ohe`o Stream

DISCUSSION AND RECOMMENDATIONS

Although `A`o were not detected during the survey, the species does exist in the park. `A`o were detected at Delta Camp (940 m [3,100 ft]) elevation on the northeastern cliffs of the Kīpahulu Valley on 24 July 1998, at around 0500 h, by Chuck Chimera (pers. comm.) who heard several loud calls from the cliffs. Patricia Welton (pers. comm.) heard `A`o at the same location in July and August 2008 from early evening to dawn. Delta Camp was not surveyed during this study. `Ake`ake were not detected during this survey but were previously detected in the park. `Ake`ake calls were heard above Kapalaoa Cabin in Haleakalā Crater on 5 August 1992, between 2000 h and 2045 h (Hodges 1992a).

During this study, nest searches were not conducted since calls of `A`o or `Ake`ake were not detected and because nest searches require extensive hiking through thick vegetation, which could cause habitat damage. Regular call-counts and nest searches for `A`o in rainforest areas are difficult. The rainy weather interferes with accurate detection. Also, these areas are only accessible by helicopter, making regular observations logistically complex and expensive to conduct. Nest searches may open routes for predators to travel to seabird nests and therefore are not recommended.

Cooper and Day (2003) conducted radar-based surveys that can serve as baseline information for `A`o. When conducted at sea level, radar surveys detect the movement of flying seabirds likely traveling to inland nesting sites. These surveys suggest that what probably were `A`o were flying inland to park lands from sea level locations at Kaupō, Mokula Point, and `Ohe`o (Cooper and Day 2003). Radar surveys were important in

detecting declines of `A`o on Kaua`i (Day et al. 2003). Follow-up radar surveys from these locations could provide insight about `A`o locations and relative population trends within HALE. Beginning in 2009, we (HALE) will begin a cooperative study with the U.S. Fish and Wildlife Service, U.S. Geological Survey, and the State Division of Forestry and Wildlife to quantify trends in populations of `Ua`u and `A`o using radar. A combination of ornithological radar and individual birds of known breeding status marked with miniature, passive radio-frequency identification (RFID) tags (a.k.a. PIT tags), will be used to establish independent quantification of the variability in breeding `Ua`u visitation patterns. Results from this study can provide insight on the feasibility of radar as a tool for estimating population trends of `A`o and `Ua`u.

Previous experience with night vision and infra-red spotlighting equipment shows that these tools are useful once the presence of nocturnally active seabirds is verified in a specific location (pers. obs.). Thermal imaging has not been used at HALE, but can also be considered. These tools could be used in conjunction with call counts and radar to survey for seabirds.

`Ake`ake calls at Haleakalā were faint and heard amid an abundance of `Ua`u calls in 1992 (Hodges 1992a). Observers during this 2005 survey may not have heard `Ake`ake calls over `Ua`u calls because `Ake`ake calls are higher-pitched and more difficult to hear. Specialized bird listening devices are designed to amplify sounds and are inexpensive (some are less than $100). Regular surveys of `Ake`ake in strategic locations (away from high density `Ua`u calls) with this type of equipment should be considered to monitor the population.

`A`o or `Ake`ake could be occupying presumed `Ua`u burrows that show signs of seabird activity. While `A`o are currently known to nest only in forested areas, there is no evidence that suggests that `A`o do not also occupy the same nesting habitat as `Ua`u. `Ua`u nests at HALE are currently monitored with indirect methods. Toothpicks are placed across the burrow entrance to determine entry by a bird and the burrow entrance is examined for signs of `Ua`u activity (e.g., footprints, feathers, guano, egg shells, etc.); `Ua`u rarely are identified with these monitoring methods. `Ua`u and `A`o body sizes and eggs are similar, so indirect signs from birds found at the burrow may be from either species. Signs from `Ake`ake may be easier to distinguish since they are much smaller than and different in color from `Ua`u or `A`o; their eggs are also considerably smaller. Some burrows do not have definite signs at the entrances (i.e., only guano is seen at the burrow entrance) and could be occupied by any of these seabird species.

Burrows at HALE should be checked to verify the species of seabird occupying each burrow. At Hawai`i Volcanoes National Park, a seabird burrow that was thought to be occupied by an `Ake`ake was actually occupied by an `Ua`u (Hodges 1992b). Observers found the burrow during daytime surveys on Mauna Loa and remained near the nest site at night to determine the bird species occupying it. `Ake`ake calls were consistently heard by observers at the burrow and they therefore expected an `Ake`ake to inhabit the burrow. Surprisingly, the bird that landed and began entering the nest was an `Ua`u.

I recommend two types of methods for verifying species of seabirds occupying burrows. Visual confirmation of the species can be achieved by looking into the burrow with a flashlight or burrow camera (Hodges 1994), by setting traps at burrow entrances to capture birds entering at night, or by observing birds that land at burrow entrances (Hodges 1992a). However, these methods can be labor-intensive (pers. obs.). Examination of genetic components of guano or bird body parts found at burrows with tests such as polymerase chain reaction (PCR) may also be useful in identifying species (Sarah Allen, pers. comm.).

The `Ua`u calls over Kuiki and Kaupō were probably from birds traveling to their nesting sites somewhere in Haleakalā Crater. Kaupō is a common route for birds to travel from the ocean to Haleakalā (pers. obs.). Kaupō Gap was surveyed more than other sites during this survey because it was logistically easier for surveyors to access. `Ua`u may not have been detected previously at these sites simply because focused surveys have not occurred at these locations.

Seabird species found along the shoreline during this survey are commonly seen at HALE. Another seabird species, `Ua`u Kani (Wedge-tailed Shearwater, *Puffinus pacificus*), commonly nests along coasts of the main Hawaiian Islands, but does not occur at HALE (Hawai`i Audubon Society 1996). The nearest `Ua`u Kani nesting colony is on the off-shore islets at Hāmoa, approximately 10 km (6.2 mi) north of `Ohe`o (Fern P. Duvall, pers. comm.). Potential nesting habitat for `Ua`u Kani exists at `Ohe`o, although cattle (*Bos taurus*) grazing that occurred along the `Ohe`o shoreline for about 100 years may have damaged potential nesting sites. Cattle were recently removed from `Ohe`o (HALE unpubl. data), and the pastures are now overgrown with dense, tall (up to one meter [3.3 ft] in height) nonnative grasses. Although these grasses may make burrow excavation and flight take-off difficult, there is a potential for `Ua`u Kani to occupy these areas in the future. Regular shoreline and trail surveys should be conducted to monitor seabird species that are visible during the day and to determine if and when `Ua`u Kani colonize `Ohe`o.

HALE is currently working with the NPS Pacific Island Network Inventory and Monitoring program to refine methods to better monitor trends in `Ua`u populations. We intend to use these methods for future `Ua`u monitoring.

Predator control and habitat recovery through ungulate removal are essential to the survival of these seabird species. Management of introduced predators and feral animals was vital in the recovery of `Ua`u in Haleakalā Crater (Hodges and Nagata 2001). HALE has a modest predator control program at `Ohe`o to limit the impact of mongooses (*Herpestes auropunctatus=javanicus*) and feral cats (*Felis catus*), animals that will depredate nesting `Ua`u Kani and other ground-nesting birds. Feral goats and pigs should be removed from Ka`āpahu where potential nesting habitat for `A`o exists.

Lastly, seabirds are dynamic and mobile. Species could enter or exit the park at any time. Follow-up inventories every 10 to 20 years could provide up-to-date information on seabird species that occur in the park.

ACKNOWLEDGEMENTS

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APPENDIX

CHECKLIST OF SEABIRDS AT HALEAKALĀ NATIONAL PARK

Common Name	Status	Scientific Name	Park Status	Abundance
Family PROCELLARIIDAE				
`Ua`u (Hawaiian Petrel)	E	Pterodroma sandwichensis (Ridgeway, 1884)	Confirmed	Common
`A`o (Newell's Shearwater)	T	Puffinus auricularis newelli (Townsend, 1890)	Probably present	Unknown
Family HYDROBATIDAE				
`Ake`ake (Band-rumped Storm-Petrel)	C	Oceanodroma castro (Harcourt, 1851)	Probably present	Unknown
Family PHAETHONTIDAE				
Koa`e Kea (White-tailed Tropicbird)		Phaethon lepturus dorotheae (Daudin, 1802)	Confirmed	Common
Family FREGATIDAE				
`Iwa (Great Frigatebird)		Fregata minor palmerstoni (J.F. Gmelin, 1789)	Confirmed	Common
Family LARIDAE				
Noio (Hawaiian Noddy)		Anous minutus melanogenys (Boie, 1844)	Confirmed	Common

CHECKLIST KEY

Status
C = Candidate species proposed for federal listing as threatened or endangered
E = Federally listed as endangered
T = Federally listed as threatened

Park Status
Confirmed = Confirmed visual or audio detection of species during these surveys
Probably present = Probably occurs in suitable habitat at Haleakalā based on historical data

Abundance
Common = Certain to be detected in proper habitat or season
Unknown = Abundance unknown

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